OPTICAL HINGE APPARATUS

FIELD OF THE INVENTION

The present invention relates generally to an optical link and, more particularly to a light guide for transmitting a light beam from one part of the light guide to another.

BACKGROUND OF THE INVENTION

In a portable electronic device such as a Nokia Communicator, which has a display that is mechanically linked to a keyboard for rotation so that the display can be collapsed upon the keyboard in a closed position or to be flipped away from the keyboard in an open position. In such an electronic device, information to be displayed on the display is conveyed from the keyboard via a flat cable, which is usually a parallel data-bus. Typically, the flat cable is connected to one flat cable connector on a circuit board of the display side and to another flat cable connector on a circuit board of the keyboard side. Flat cable is comprised of a plurality of metal wires to carry electrical current, and these metal wires are individually surrounded by a protective jacket. Bad connections are known to occur to the flat cable connectors over time. Furthermore, sharp objects and corrosive agents can accidentally break the flat cable, thereby interrupting the communication between the display and the keyboard. Moreover, a flat cable has a width depending on the number of wires. With a 50-pin parallel bus, the width of the flat cable and the connectors can occupy a large area of the display, the printed circuit board (PCB), and the keyboard.

It is advantageous and desirable to provide an optical link between the display and the keyboard in a portable electronic device so that data communication between the display and the keyboard can be carried out with optical signals, instead of electrical signals. The optical link can eliminate the problems associated with the flat cable and the flat cable connectors.

SUMMARY OF THE INVENTION

The object of the invention is to use a small number of optical devices to provide a communication link between two circuit boards. Preferably, the optical devices are capable of carrying communication data in a serial manner.

Thus, the first aspect of the present invention is an optical hinge, which serves as a light guide to convey communication data in optical signals between two circuit boards having opto-electronic devices for transmitting and receiving optical signals. The optical hinge is comprised of:

- a first optical component having a first cavity for optically coupling the first optical component to a first opto-electronic device, which is capable of providing a light beam, so as to allow the light beam to be transmitted through the first cavity along a first optical path; and
- a second optical component having a second cavity for optically coupling the second optical component to the second opto-electronic device, wherein the second optical component is capable of rotating relative to the first optical component at a rotation angle along a rotation axis, and wherein the first optical component has a first reflecting surface for directing the light beam transmitted along the first optical path towards the second optical component along a second optical path, and wherein the second optical component has a second reflecting surface to redirect the light beam transmitted along the second optical path towards the second cavity along a third optical path, so as to allow the light beam to reach the second opto-electronic device.

Preferably, the first and second reflecting surfaces are total internal reflection surfaces.

Preferably, the first cavity has a spherical surface for focusing the light beam prior to the light beam being transmitted along the first optical path.

Preferably, the first reflecting surface is a spherical surface, for example, for focusing the light beam while directing the light beam towards the second optical path.

Preferably, the first optical component has at least one socket and the second optical component has at least one stud mechanically engaged in the socket, so as to allow the second optical component to rotate relative to the first optical component along the rotation axis.

The second aspect of the present invention is an optical hinge apparatus for providing an optical link between a first circuit board having a first opto-electronic device capable of providing a light beam and a second circuit board having a second opto-electronic device, wherein the first circuit board is mechanically linked to the second circuit board, so as to allow the second circuit board to rotate relative to the first circuit board along a rotation axis. The optical hinge apparatus comprises:

- a first optical component mounted on the first circuit board; and
- a second optical component mounted on the second circuit board, wherein the first optical component has a first boundary surface, and the second optical component has a second boundary surface adjacent to the first boundary surface, defining an air gap, which is substantially located on the rotation axis, and wherein the first optical component is optically coupled to first opto-electronic device to receive the light beam in order to transmit the light beam through the air gap to the second optical component, and wherein the second optical component is optically coupled to the second opto-electronic device in order to transmit the light beam to the second opto-electronic device.

Preferably, the first optical component has a first cavity for optically coupling the first optical component to the first opto-electronic device, so as to allow the light beam to be transmitted through the first cavity along a first optical path, and the second optical component has a second cavity for optically coupling the second optical component to the second opto-electronic device.

Preferably, a plurality of electrically conducting wires are used to connect the first circuit board and the second circuit board to a power source in order to provide electrical power to the first and second opto-electronic devices.

Preferably, the first optical component has a first reflecting surface to direct the light beam transmitted along the first optical path towards the second optical component along a second optical path, and wherein the second optical component has a second reflecting surface to redirect the light beam transmitted along the second optical path towards the second cavity along a third optical path, so as to allow the light beam to reach the second opto-electronic device.

Preferably, the second optical path is parallel to or substantially coincident with the rotation axis.

Preferably, the first circuit board has at least one mounting pin and the first optical component has at least a mounting hole engaged with the mounting pins for mounting the first optical component to the first circuit board.

The present invention will become apparent upon reading the description taken in conjunction with FIG. **1** to **9***b*.